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(54) Apparatus for treatment of rhinitis by biostimulative illumination.

(57) Apparatus for treating rhinitis by illumination including at least one light emitting diode (LED) pack, each having a plurality of light emitting diodes (LEDs), suitable for insertion into at least one, respective, rhinitis affected nostril and operative for illuminating a rhinitis affected zone of the interior surface of the at least one nostril with non-coherent light radiation, the light radiation having a narrow bandwidth centered at a wavelength suitable for rhinitis treatment. Preferably, the rhinitis affected zone is illuminated continuously for a prescribed treatment duration.

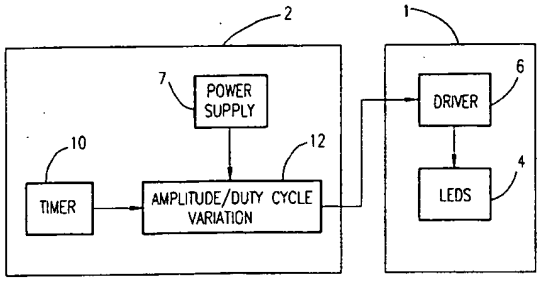

FIG. 1

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The present invention relates to apparatus for light therapy in general and, more particularly, to devices and methods for treating the rhinitis.

Clinical symptoms of rhinitis such as a runny nose, an itchy nose, post nasal drainage of mucus and, in extreme cases, congested secondary air passages, may be attributed to various etiologies. The common etiologies are viral infection, such as infectious rhino sinusitis. Other etiologies include allergic, perennial, or seasonal rhinitis, also known as "hay fever", non allergic vasomotor rhinitis, eosinophyllic rhinitis and nasal polyps.

Existing methods of treatment of the above mentioned rhinitis symptoms include systematic use of medications, such as antihistamines and decongestants, or local treatment with steroid spray, D.S.C.G. or local decongestants. There have been also attempts to treat rhinitis locally by applying a "fog stream", i.e. a stream of water at a temperature of approximately 42 • C.

It is appreciated that non of the existing treatments described above, nor any combinations thereof, completely relieve rhinitis related symptoms. Therefore, a large population is helplessly exposed to the irritating discomforts of rhinitis symptoms.

Light therapy is known for treating a variety of patient complaints and ailments. A state of the art device suitable for administering light therapy is disclosed in United States Patent 4,930,504 to Diamantopoulos et al. Diamantopoulos et al hypothesize that the disclosed device may be used, "for example, to treat inflammations, wounds, burns, chronic ulcerations including diabetic ulcers, deficient circulation, pain, nerve degeneration, eczema, shingles, infection, scars, acne, bone fractures, muscle and ligament injuries, arthritis, osteo-arthritis, rheumatiodal arthritis, skin grafts, gingival irritation, oral ulcers, dental pain and swelling, cellulitis, stretch marks, skin tone, alopecia areata, trigeminal neuralgia, herpes, zosten, sciatica, cervical erosions and other conditions."

Diamantopoulos et al teach the use of an array of substantially monochromatic radiation sources of a plurality of wavelengths, preferably of at least three different wavelengths. The sources radiate in accordance with a high duty-cycle pulsed rate, and are arranged within the array such that radiation of at least two different wavelengths passes directly or indirectly through a single point located within the treated tissue.

Use of LEDs in administering light therapy for the treatment of certain ailments and complaints is disclosed in Applicant's published UK Application GB 2212010A.

The present invention seeks to provide a device for therapeutic illumination which is particularly suited for treatment of rhinitis. The device of the present invention is suitable for treatment of various nasal conditions.

There is thus provided, in accordance with a preferred embodiment of the present invention, apparatus for treating rhinitis by illumination including at least one light emitting diode (LED) pack, each having a plurality of light emitting diodes (LEDs), suitable for insertion into at least one, respective, rhinitis affected nostril and operative for illuminating a rhinitis affected zone of the interior surface of the at least one nostril with non-coherent light radiation, the light radiation having a narrow bandwidth centered at a wavelength suitable for rhinitis treatment.

In a preferred embodiment, the non-coherent light radiation is continuous wave (CW) light radiation.

Preferably, the narrow bandwidth comprises a red light bandwidth. More preferably, the red light wavelength is approximately 660 nm.

In a preferred embodiment of the invention, the LED pack comprises at least one concentric circular arrangement of LEDs. Preferably, each of the LEDs emits a cone of light and the LEDs are arranged and configured such that the plurality of cones of light illuminate a common area of said zone.

Preferably, the rhinitis affected zone is illuminated at a power concentration level of between approximately one milliwatt per squared centimeter and approximately thirty milliwatts per squared centimeter.

According to one, preferred, embodiment of the invention the apparatus for treating rhinitis further includes a support arrangement, adapted for mounting on the face of a user and operative for supporting the at least one LED pack at a position suitable for biostimulative treatment of the at least one rhinitis affected nostril.

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the following drawings in which:

Fig. 1 is a simplified block diagram functionally showing apparatus for treating rhinitis, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 shows the LEDs of Fig. 1 in greater detail;

Fig. 3 is a schematic, pictorial, illustration of apparatus for treating rhinitis, constructed and operative in accordance with one preferred embodiment of the present invention;

Fig. 4 is a schematic, pictorial, illustration of apparatus for treating rhinitis, constructed and operative in accordance with another preferred embodiment of the present invention; and

Fig. 5 is a schematic, pictorial, illustration of apparatus for treating rhinitis, constructed and operative in accordance with yet another pre-

ferred embodiment of the present invention.

Referring to Fig. 1, there is shown a compact light source 1 and an associated control unit 2 which preferably has a CW (continuous wave) mode of operation. Light source 1 preferably comprises a plurality of light emitting diodes (LEDs) 4 which receive power via a driver circuit 6. Preferably, each of LEDs 4 emits light of substantially the same frequency.

Control unit 2 includes a power supply 7 and a timer 10 which may include a standard clock circuit provided with "set time" switches, and whose function is to disable the control circuit 2 after a preset time has elapsed. Power supply 7 preferably includes a battery, such as a lithium battery, or an AC/DC converter which draws electric power from the grid.

An amplitude and/or duty cycle variation circuit 12 provides a direct current (DC) signal with a variable amplitude and/or duty cycle which is fed to driver 6 of light source 1. Thus, light source 1 emits light continuously with a magnitude and/or duty cycle determined by amplitude/duty cycle variation circuit 12.

In a preferred embodiment of the invention, LEDs 4 are driven by driver 6 in the CW mode of operation controlled by control unit 2. Experimental results show that a pure CW mode of operation is more effective than either a PW (pulsed wave) mode of operation or any combination of the two modes.

Fig. 2 shows a preferred embodiment of LEDs 4 in detail. The LEDs 4 are arranged in the form of an LED pack 20 including a preselected number of LEDs. In the example shown in Fig. 2, LED pack 20 includes three LEDs, 22, 23 and 24, connected in series. LEDs 22, 23 and 24 are preferably connected, in series with a resistor 26 which limits the current flowing through the LEDs, between a high voltage DC rail 28 and a low voltage DC rail 30. In the example of Fig. 2, one terminal of series resistor 26 is connected to high voltage rail 28 whilst the cathode of LED 24 is connected to low voltage rail 30.

According to an alternative embodiment of the invention, series resistor 26 and power supply 7 may be replaced by a current source.

Fig. 3 shows a preferred arrangement of LED pack 20 which is shown schematically in Fig. 2. LEDs 4 are preferably mounted on a support base 40 and arranged such that their light outputs illuminate a defined zone 42, for example a rhinitis-afflicted region of the internal surface 45 of a human nostril 50. In a preferred embodiment of the invention, zone 42 which LEDs 4 illuminate is adapted to cover most of the internal surface of a typical human nostril with substantially homogeneous illumination intensity. The LEDs may be arranged in any suitable manner on base 40, for example in one or more concentric circles. It will be understood that, generally, the number of LEDs included in LED pack 20 of Fig. 2 controls the light output intensity of light source 1 (Fig. 1).

It will be appreciated that each of LEDs 4 emits a cone of light, and the LEDs are configured and arranged such that the plurality of cones of light emitted by the plurality of LEDs intersects over zone 42, such that more than one of LEDs 4 illuminate a common area of zone 42. Preferably, every point of zone 42 is illuminated by more than one of LEDs 4.

During operation, amplitude and/or duty cycle variation circuit 12 provides a DC voltage with variable amplitude and/or duty cycle between high voltage supply rail 28 and ground terminal 30. Thus, by varying the setting of amplitude/duty cycle variation circuit 12, the overall current flowing through LED pack 20 may be varied and, thereby, the light intensity provided by light source 1 is varied. As mentioned above, it is preferred that variation circuit 12 is set to a substantially continuous-wave mode of operation.

A preferred power level is between 1 - 30 mW/cm^2, for example 10 mW/cm^2.

Thus, the invention affords low cost apparatus for treating rhinitis by producing a non-coherent source of illumination, preferably in CW mode, which is focussed over a predefined area. In a preferred embodiment of the invention, the exact wavelength of the illumination is confined to a relatively narrow bandwidth (+/- 25 nm) centered at a wavelength which may be predetermined and provided by suitable selection of LEDs 4 in LED pack 20. Experimental evidence indicates that red light, particularly 660 nm light, is particularly suitable for the treatment of rhinitis. The average intensity of the emitted illumination may be varied by the operator, and the therapy duration may be preset by means of the integral timer circuit 10.

Reference is now made to Fig. 4 which schematically illustrates an alternative, preferred, embodiment of the invention which may be particularly useful for patients requiring repeated treatment over prolonged periods of time. According to this embodiment, at least one light source 1 is securely, yet adjustably, mounted on a generally rigid support arrangement 70 which is mounted, in turn, on the face of a user. Support arrangement 70 preferably includes two ear supports 72 and a nose-top support 74, such as the ear and nose supports of eye glasses, so as to provide secure mounting of arrangement 70 on the face of the user. Each of the at least one light sources 1 is preferably mounted on an adjustable downward extension 76 of arrangement 70. Fig. 4 shows two light sources 1 mounted on two respective exten-

sions 76 of arrangement 70, which are adjusted such that light sources 1 operatively engage the two nostrils of the user, respectively.

Light sources 1 are preferably powered and controlled, via suitable wires 75, by a control unit 78, similar to control unit 2 (Figs. 1 - 3) but adapted to power and control more than one light source 1. Control unit 78 may be hand held or mounted to any suitable location on the user or placed at any other suitable location. Using this preferred embodiment of the invention, biostimulative illumination treatment as described above may be conveniently applied to both nostrils simultaneously.

Reference is now made to Fig. 5 which schematically illustrates another alternative, preferred, embodiment of the invention, wherein light source 1 and control unit 2 (Figs. 1 - 3) are integrated into a single light treatment device 80. Treatment device 80 preferably includes an elongated, preferably pen-shaped, housing 82 which encloses circuitry substantially equivalent to that of control unit 2 and light source 1. A LED pack 84, which may be identical to LED pack 20 (Fig. 3), is disposed at one end of housing 82 and connected to the circuitry in housing 82 in the manner described above with reference to Fig. 2.

During operation, treatment device 80 may be hand held by the user, preferably at a prescribed position suitable for biostimulative illumination treatment. When device 80 is properly positioned, LED pack 84 operatively engages a rhinitis affected nostril for biostimulative treatment thereof, as described above with reference to Figs. 1 - 3. Device 80 is preferably powered by a compact power source, such as a lithium battery.

It will be appreciated that the particular features of the methods and apparatus shown and described herein may be employed separately or in combination in any suitable manner so as to enhance efficacy of treatment.

Devices for treatment by illumination are disclosed in Published UK application GB 2212010A. However, it is believed that the embodiments described hereinabove, with reference to Figs. 1 - 5, are preferred embodiments for treatment of rhinitis.

Experimental results indicate that most effective treatment of rhinitis symptoms, particularly those associated with the nostrils, is achieved when using light in the red bandwidth illuminated in a CW mode of operation. The experiments show a success rate of approximately 70 percent in relieving rhinitis symptoms, such as runny and/or itchy noses and post nasal drainage of mucus.

A preferred rhinitis treatment session, derived from actual experimental trials, will now be described. In a preferred embodiment of the invention, as shown in Fig. 3, LED pack 20 of light source 1 is preferably inserted to one of nostrils 50 of a rhinitis-suffering human nose 60 and, then, activated for a preselected treatment duration, for example three minutes. Then, light source 1 is removed from the treated nostril 50 and inserted to the other, untreated, nostril 50 for substantially the same treatment. This completes one rhinitis treatment session. For best results, the session described above is performed repeatedly, a number of times each day, over long periods of time, typically a few months.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather, the scope of the present invention is defined only by the claims that follow:

Claims

1. Apparatus for treating rhinitis by illumination comprising at least one light emitting diode (LED) pack, each including a plurality of light emitting diodes (LEDs), suitable for insertion into at least one, respective, rhinitis affected nostril and operative for illuminating a rhinitis affected zone of the interior surface of the at least one nostril with non-coherent light radiation, said light radiation having a narrow bandwidth centered at a wavelength suitable for rhinitis treatment.

2. Apparatus for treating rhinitis by illumination according to claim 1 and wherein the non-coherent light radiation is continuous wave (CW) light radiation.

3. Apparatus according to claim 1 or claim 2 wherein the narrow bandwidth comprises a red light bandwidth.

4. Apparatus according to claim 3 wherein the red light wavelength is approximately 660 nm.

5. Apparatus according to any of the preceding claims wherein the LED pack comprises at least one concentric circular arrangement of LEDs.

6. Apparatus according to any of the preceding claims wherein each of the LEDs emits a cone of light, and wherein the LEDs are arranged and configured such that the plurality of cones of light illuminate a common area of said zone.

7. Apparatus according to any of the preceding claims wherein the rhinitis affected zone is illuminated at a power concentration level of between approximately one milliwatt per squared centimeter and approximately thirty

milliwatts per squared centimeter.

8. Apparatus according to claim 7 wherein the rhinitis affected zone is illuminated at a power concentration level of approximately ten milliwatts per squared centimeter.

9. Apparatus according to any of the preceding claims and further comprising a support arrangement, adapted for mounting on the face of a user and operative for supporting said at least one LED pack at a position suitable for biostimulative treatment of said at least one rhinitis affected nostril.

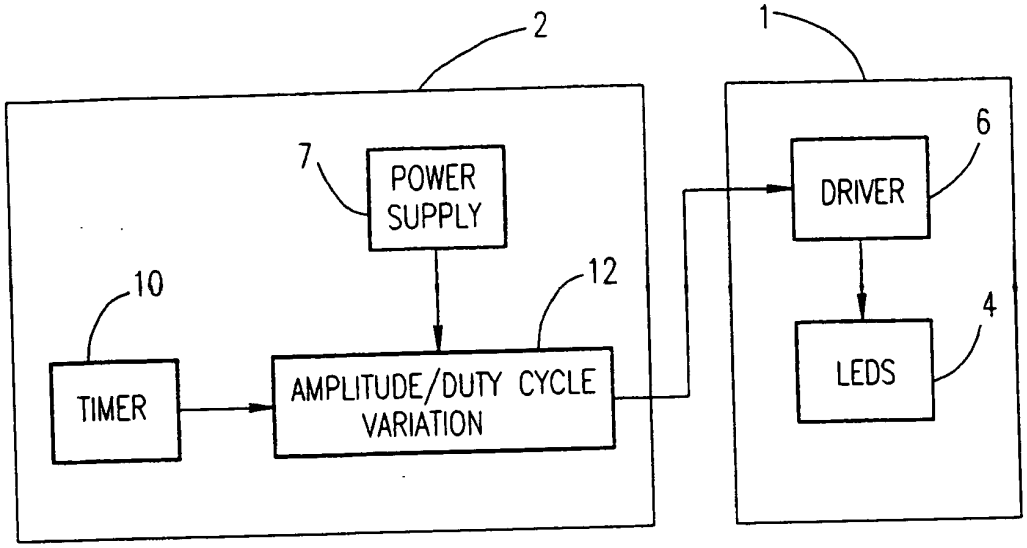
2
1
7
POWER SUPPLY
6
DRIVER
10
12
4
TIMER
AMPLITUDE/DUTY CYCLE VARIATION
LEDS

FIG. 1

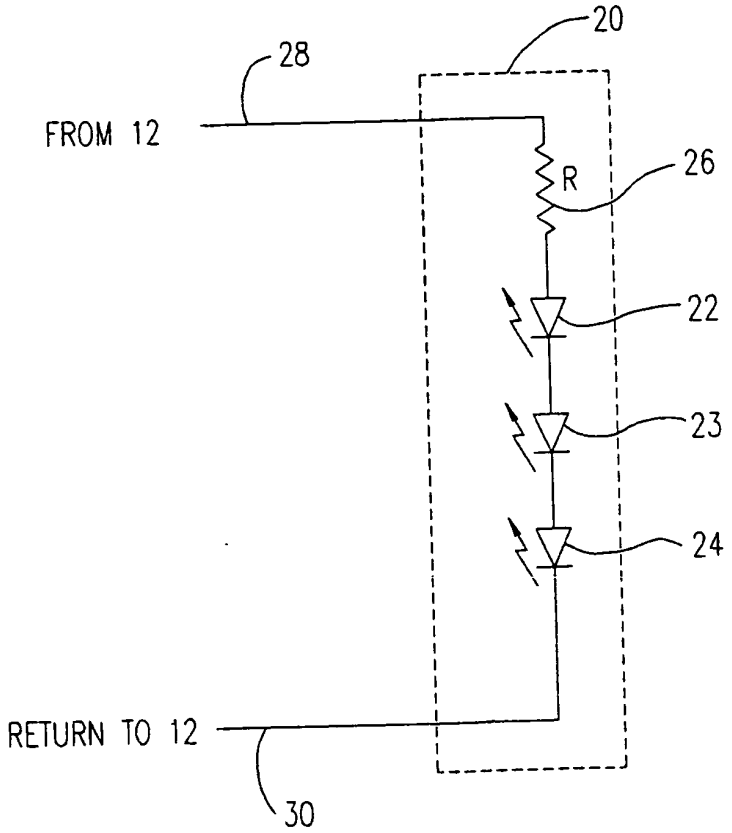
20
28
FROM 12
R
26
22
23
24
RETURN TO 12
30

FIG. 2

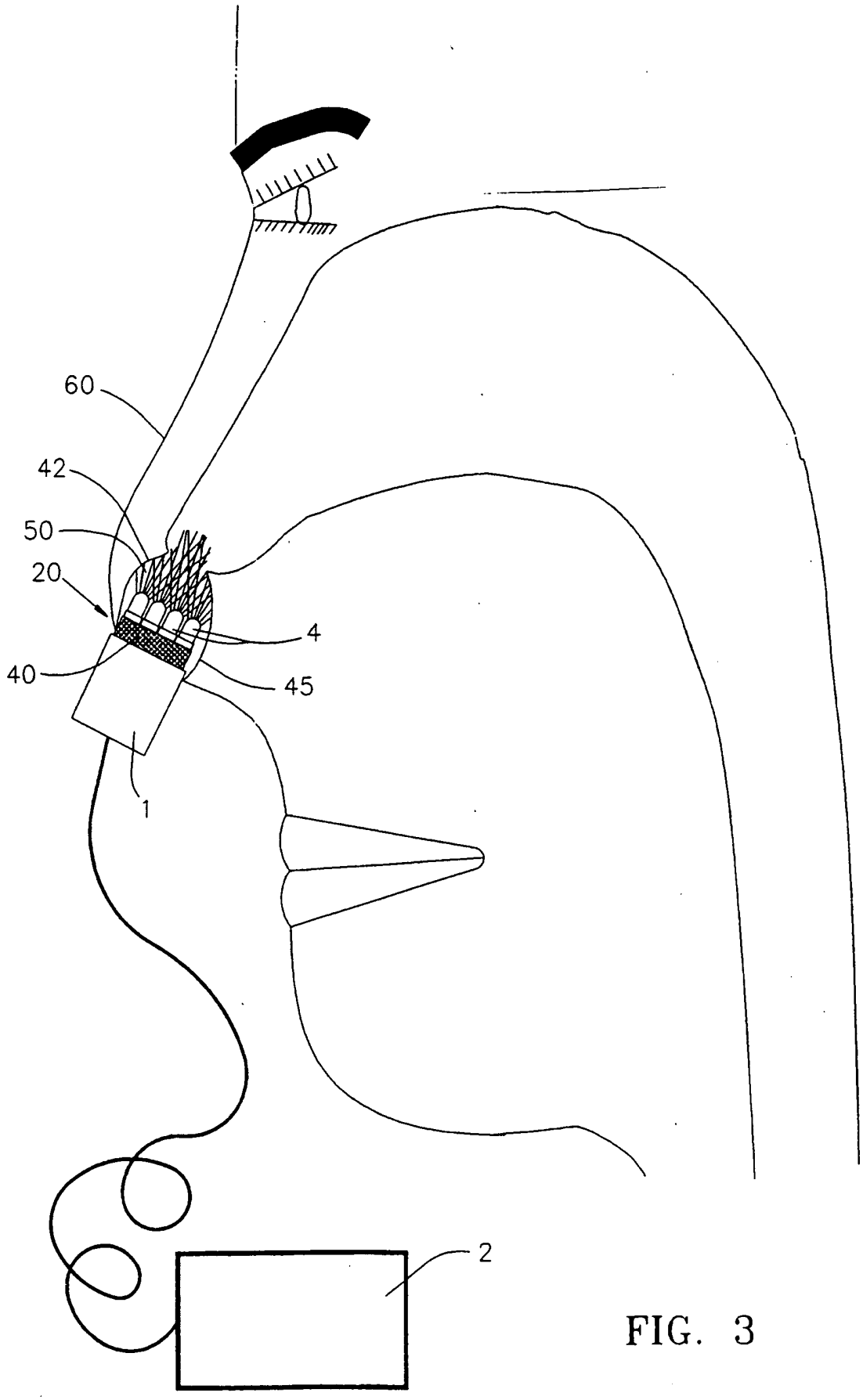

FIG. 3

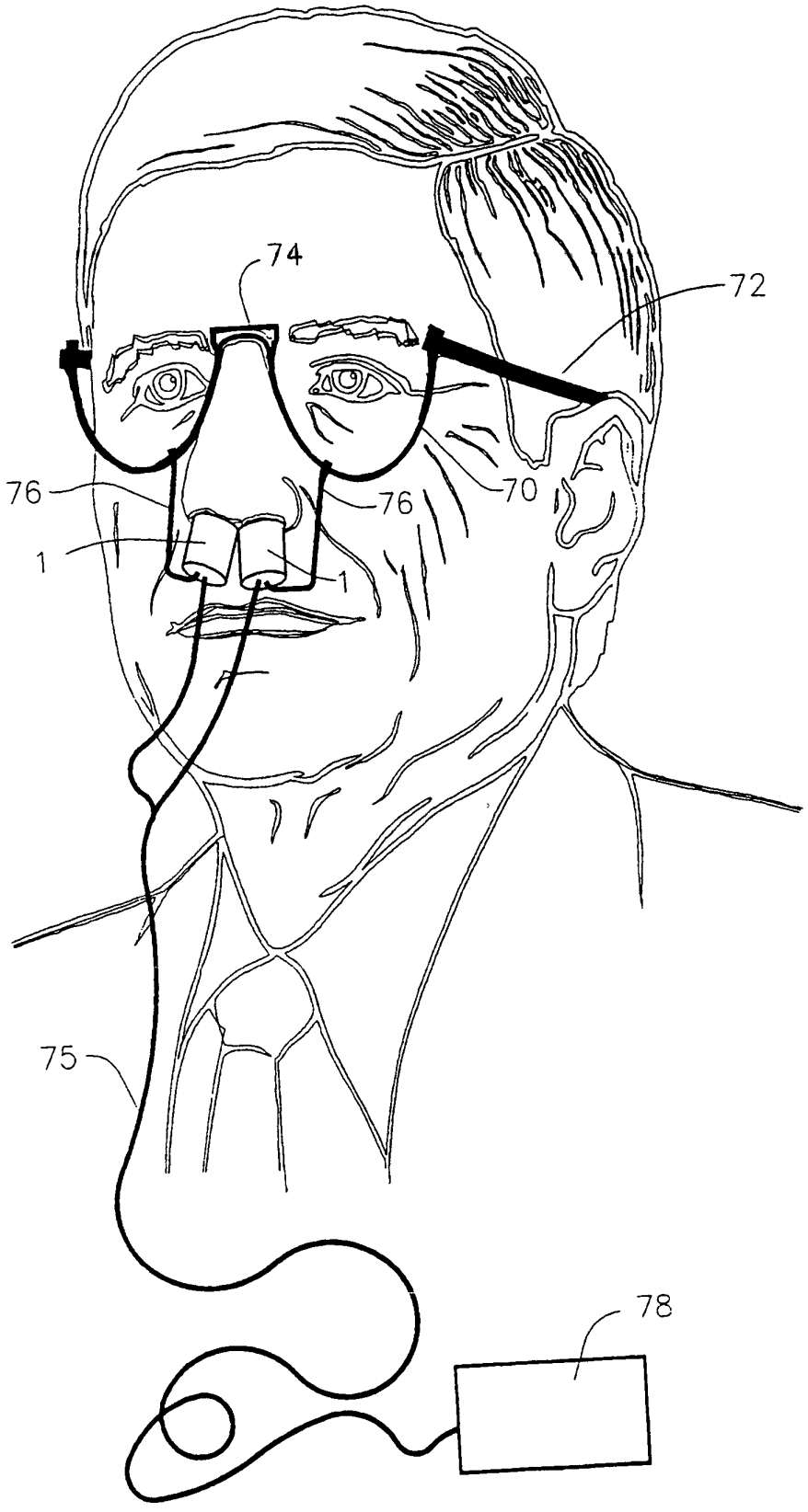

FIG. 4

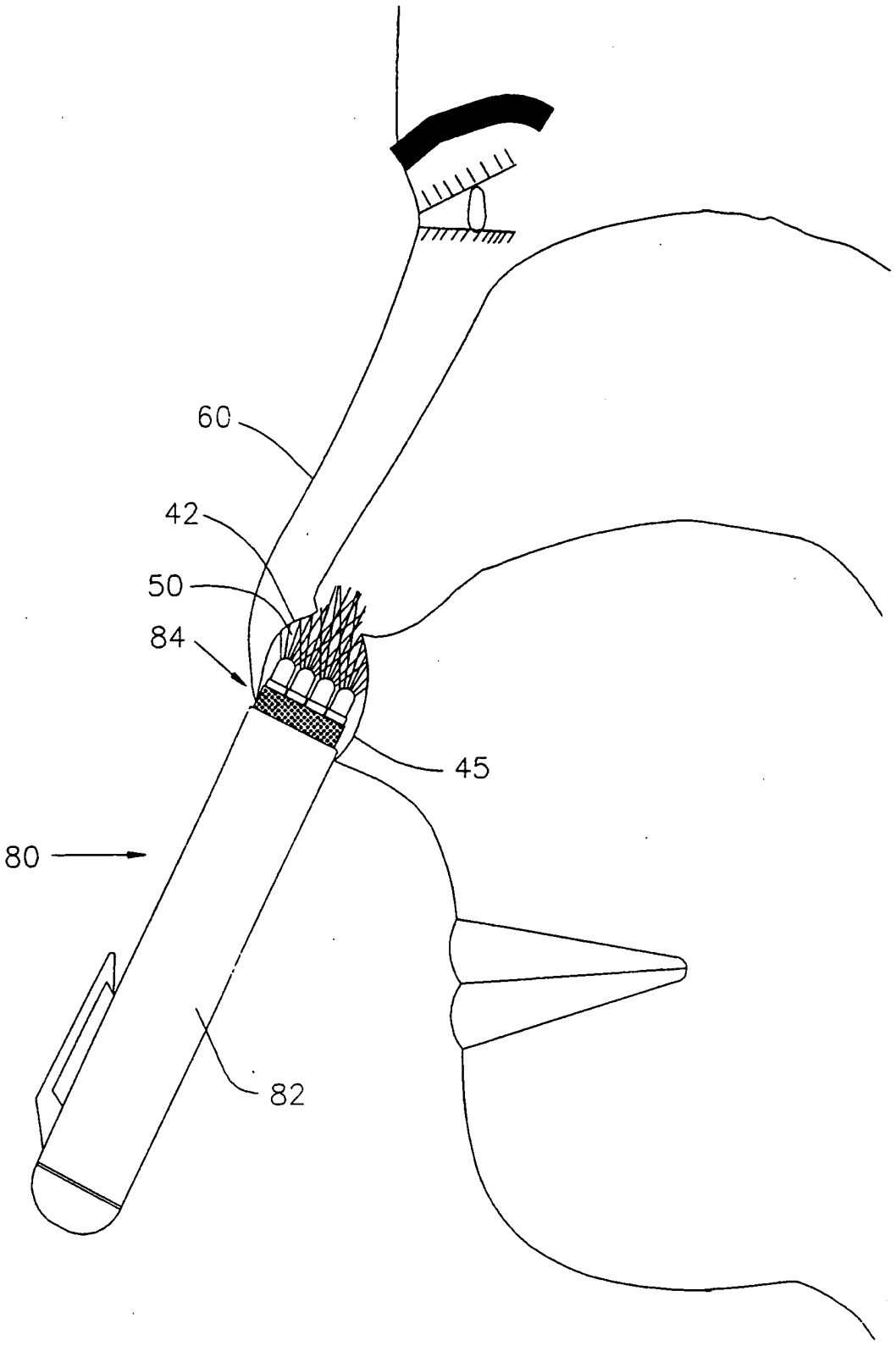

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 30 6130

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-30 23 130 (BLÜCHER) * the whole document * ---	1	A61N5/06
A	FR-A-644 157 (KAHL & LANDAU) * the whole document * ---	1,9	
X	US-A-4 646 743 (PARRIS) * column 3, line 11 - column 4, line 6 * -----	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A61N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 June 1995	Lemercier, D

CATEGORY OF CITED DOCUMENTS

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